Discussion of the Obviousness Rejection

The obviousness rejection of claims 1, 3-6, 8, 9, and 16-27 is respectfully traversed for the reasons set forth herein.

The invention is directed to a polishing system comprising a liquid carrier, an oxidizing agent, a polishing additive that increases the polishing rate, a passivation film-forming agent, and a polishing pad and/or abrasive. The Office Action asserts that Sasaki teaches all the elements of the claimed polishing system including a liquid carrier (e.g., water), an oxidizing agent (e.g., H_2O_2), a polishing additive (e.g., phosphonic acids), film-forming agents (e.g., benzotriazole), and an abrasive, except for teaching the specific polishing additives recited in the pending claims. The Office Action further asserts that the phosphonic acid "polishing additives" of Sasaki are "equivalent" to those disclosed by Kaufman, thus rendering obvious the substitution of one phosphonic acid for another. However, the line of reasoning set forth in the Office Action is flawed because (1) the phosphonic acids of Sasaki are not polishing additives as defined by the pending claims and (2) the phosphonic acids of Sasaki are not equivalent to those disclosed by Kaufman as suggested by the Office Action.

Sasaki discloses that phosphonic acids should be used as agents for forming a protective film on the substrate surface. Such agents are disclosed as preferably hydrophobic organic compounds (col. 3, lines 55-57). Indeed the only example of a phosphonic acid is octane phosphonic acid, which contains a hydrophobic long chain alkyl (octyl) group. Sasaki teaches that film-forming agents such as hydrophobic phosphonic acids are used to *suppress* the rate of chemical polishing (col. 3, lines 17-25). Accordingly, the hydrophobic phsophonic acids are not polishing additives which *increase* the polishing rate of a substrate layer, as recited in the pending claims.

Moreover, unlike the phosphonic acid compounds of Sasaki, the phosphonic acid compounds disclosed by Kaufman contain methylene or ethylene groups (no long alkyl chains or other hydrophobic groups) and multiple phosphonic acid groups. Thus, the phosphonic acid compounds of Kaufman are not hydrophobic, but are substantially hydrophilic. The differences in hydrophobicity/hydrophilicity are reflected in the polishing properties of these compounds. Examples 1, 3, 4, 5, and 6 of the instant specification demonstrate that the presence of polyphosphonic acids such as Dequest® 2000, Dequest® 2010, and Dequest® 2060 in polishing compositions substantially increases the removal rates of copper-containing substrate layers compared to polishing compositions that do not contain the polyphosphonic acids. Thus, the hydrophilic phosphonic acids as taught by Kaufman have exactly the opposite effect on the polishing rate as the hydrophobic phosphonic acids

taught by Sasaki. Clearly, the phosphonic acids of Sasaki are not "equivalent" to those of Kaufman since they have opposite properties with regard to chemical polishing.

Even if the hydrophobic phosphonic acids of Sasaki were equivalent, or even similar, to the polyphosphonic acids of Kaufman, there in nothing in the references themselves, or in the knowledge available to the ordinarily skilled artisan at the time of the invention, that suggests that the phosphonic acid of Kaufman could be interchanged with that of Sasaki. Sasaki teaches that phosphonic acids form a film on the surface of the substrate. Kaufman teaches that phosphonic acids are suspended within the polishing composition and prevent settling, flocculation, and decomposition. One of ordinary skill in the art would not be motivated to take a phosphonic acid used to affect abrasive particle interactions (as taught by Kaufman) and use it to form a protective film in a method as taught by Sasaki. Based on the combined teachings of the cited references, the ordinarily skilled artisan would expect that the phosphonic acids of Kaufman would not be able to form films since they would be used up in chemical or abrasive interactions aimed at preventing particle agglomeration or preventing decomposition of the oxidizing agent. Indeed, after testing the effectiveness of the polyphosphonic acids as film-forming agents, the ordinarily skilled artisan would quickly discover that they do not act to protect the substrate surface at all but actually act to hasten the substrate surface removal. Furthermore, nothing in Sasaki teaches or suggests the desirability of incorporating a stabilizer component as taught by Kaufman, nor does Sasaki even recognize the existence of any of the problems of settling, flocculation, or decomposition of the polishing compositions. Thus, one of ordinary skill in the art would not be motivated to include a polyphosphonic acid stabilizer as disclosed by Kaufman in the polishing composition of Sasaki, particularly in the absence of any guidance to select a phosphonic acid over a surfactant or dispersing agent which are also disclosed as effective for combating settling, flocculation, and decomposition.

Since the cited references fail to teach or provide any suggestion to form a polishing composition comprising both a polishing additive that increases the removal rate and a passivation film-forming agent as recited by the pending claims, the obviousness rejection is improper and should be withdrawn.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 1765

PATENT
Attorney Docket No. 98124x205487

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Wang et al.

Application No. 09/636,161

Art Unit: 1765

Examiner: Lynette T. Umez-Eronini

Filed: August 10, 2000

For: POLISHING SYSTEM AND METHOD OF ITS USE

PENDING CLAIMS AFTER AMENDMENTS MADE IN RESPONSE TO OFFICE ACTION DATED JUNE 18, 2002

1. A system for polishing one or more layers of a multi-layer substrate that includes a first metal layer and a second layer comprising (i) a liquid carrier, (ii) at least one oxidizing agent, (iii) at least one polishing additive that increases the rate at which the system polishes at least one layer of the substrate, wherein the polishing additive is selected from the group consisting of pyrophosphates, condensed phosphates, diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids, and salts thereof, aminoethylethanolamine, polyethyleneimine, amino alcohols, amides, imines, imino acids, nitriles, nitros, thioesters, thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, thiosalicylic acids, and mixtures thereof, (iv) at least one passivation film forming agent, and (v) a polishing pad and/or an abrasive

2. The system of claim 1, wherein the liquid carrier is a nonaqueous solvent.

3. The system of claim 1, wherein the liquid carrier is water.

4. The system of claim 3, wherein the system comprises an abrasive suspended in the liquid carrier.

5. The system of claim 3, wherein the abrasive is fixed on the polishing pad.

6. The system of claim 3, wherein no abrasive is present in the system, and the polishing pad is a non-abrasive pad.

8. The system of claim 3, wherein at least one oxidizing agent is a peroxide, and at least one passivation film forming agent comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

9. The system of claim 3, wherein at least one polishing additive is selected from the group consisting of ethylene di-phosphonic acid, 1-hydroxyethylidene-1,1-di-phosphonic acid, and a mixture thereof. search

16. The system of claim 9, wherein at least one oxidizing agent is a peroxide, and at least one passivation film forming agent comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

17. The system of claim 3, wherein at least one polishing additive is both (a) a compound selected from the group consisting of pyrophosphates, condensed phosphates, phosphonic acids and salts thereof, and (b) a compound selected from the group consisting of amines, amino alcohols, amides, imines, imino acids, nitriles, and nitros.

18. The system of claim 3, wherein at least one polishing additive is both (a) a compound selected from the group consisting of amines, amino alcohols, amides, imines, imino acids, nitriles, and nitros, and (b) a compound selected from the group consisting of thioesters, and thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, and thiosalicylic acids.

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19. The system of claim 17, wherein at least one polishing additive is selected from the group consisting of 2-aminoethyl phosphonic acid, amino(trimethylenephosphonic acid), diethylenetriaminepenta(methylenephosphonic acid), hexamethylenediaminetetra(methylene phosphonic acid), and mixtures thereof.

20. The system of claim 3, wherein the system further comprises a source of ammonia.

21. The system of claim 20, wherein the system comprises (i) aminotri-(methylenephosphonic acid) and (ii) ammonia or an ammonium salt.

22. The system of claim 3, wherein the system further comprises at least one stopping compound.

23. The system of claim 3, wherein the system further comprises at least one polymeric compound that reduces the polishing rate of at least one layer associated with the substrate.

24. The system of claim 3, wherein at least one passivation film-forming agent is selected from the group consisting of 1,2,3-triazole, 1,2,4-triazole, benzotriazole, benzimidazole, benzothiazole, and hydroxy-, amino-, imino-, carboxy-, mercapto-, nitro-, urea-, thiourea-, or alkyl-substituted derivatives thereof

known in art

25. The system of claim 3, wherein the abrasive is a metal oxide abrasive.

26. The system of claim 25, wherein the abrasive is selected from the group consisting of alumina, ceria, germania, silica, titania, zirconia, and coformed products thereof, and mixtures thereof.

27. The system of claim 26, wherein the abrasive is alumina.

objected

32. The system of claim 1, wherein at least one polishing additive is iminodiacetic acid.

33. The system of claim 32, wherein the system further comprises at least one stopping compound.

34. The system of claim 32, wherein the system further comprises at least one polymeric compound that reduces the polishing rate of at least one layer associated with the substrate.

35. The system of claim 22, wherein the system further comprises ammonia or an ammonium salt.